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With the support of DURIP funding, we have developed the hardware leading to the world's only filter-based magnetograph for the near IR. The heart of such a system includes a Fabry-Perot filter following a prefilter which is sufficiently narrow to ensure that it knocks out all the side bands of the Fabry-Perot (i.e. the filter's pass band is narrower than the free spectral range of the Fabry Perot) . The required IR Fabry-Perot system exists; we have purchased one from the Queen sgate with DURIP funds. Nonetheless, there are no such magnetographs, at present, for measuring the evolution of magnetic fields in lB.

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**NJIT**
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*A Public*
*Research University*

DEPARTMENT OF PHYSICS

October 1, 2001

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To whom it may concern:

Below is my final report on F49620-00-1-0197.

Sincerely,
Philip Goode
Philip Goode

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Final Technical Report of the DURIP Award F49620-00-1-0197:

With the support of DURIP funding, we have developed the hardware leading to the world's only filter-based magnetograph for the near IR. The heart of such a system includes a Fabry-Perot filter following a prefilter which is sufficiently narrow to ensure that it knocks out all the side bands of the Fabry-Perot (i.e. the filter's pass band is narrower than the free spectral range of the Fabry-Perot). The required IR Fabry-Perot system exists; we have purchased one from the Queensgate with DURIP funds. Nonetheless, there are no such magnetographs, at present, for measuring the evolution of magnetic fields in IR.

The missing element has been an IR, narrow band Lyot prefilter (counterpart to what is used in the best visible light magnetographs). An NJIT Ph.D. student has designed such a filter, tested all the optical components, and Cambridge Research Inc. is currently doing the final assembly. The student, Jingshan Wang, has finished his Ph.D. thesis in May, 2001.

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The Description of the System

In a filter-based magnetograph, there are basic three sections: prefilter, magnetic analyzer, and a narrow-band filter. The prefilter is the most important and difficult part of the system. The requirements for high spectral resolution, high throughput, and tunability, have led us to

The conclusion that the best system would be a combination of a Fabry- Perot Etalon and a birefringent filter.

The free spectral range of the Fabry-Perot Etalon we purchased use is 5.487 A. Therefore, the FWHM of the narrowest element in this infrared birefringent filter must be no more than 5.487 A. To eliminate the side bands of the transmission profile, we have designed the FWHM of the narrowest element to be 2.7435 A. There are 4 stages for the filter, each reduced the bandwidth by a factor of 2 from the previous stage.

To increase the field of view and decrease the error due to installation, wide-field configurations are used. A wide-field configuration means that the crystal is split into two equal half plates and a 1/2 waveplate is sandwiched between them. A 1/2 waveplate has a phase difference of pi between the o and e light.

This birefringent filter is designed to be tunable so as to pass either one or the other of the two magnetically sensitive lines--FeI 15648.5 A (g = 3) or FeI 15652.8 A (g = 1.53). Another advantage of such a tunable filter is that it is easier to calibrate the wavelength of the bandpass. The tuning of each element is done by a liquid crystal variable retarder as a variable compensator.

Durip funding has enabled us to construct a near IR polarimeter that functions with the elegance of those for visible light. Magnetometry in in near IR is extremely important because the seun has an opacity minimum in that region and, thus, we are able to see beneath the sun's visible surface. Furthermore, the Zeeman splitting increases quadratically with incresing wavelength, so that we can detect weaker fields. Finally, the earth's atmosphere is more stable in the near IR, so that the effects of atmospheric turbulence are natually minimized.